**Title**: Analyzing the impact of co-morbid obesity on infection outcomes in a large ICU dataset

**Background**: Co-morbid conditions provide a significant challenge to infection management, causing increased complexity and uncertainty. Obesity is a major driver of co-morbidities with its prevalence continuing to increase given modern diets and lifestyles. Hence many obese patients fail to be treated appropriately leading to significant health inequalities. We investigated the current impact of co-morbid obesity on infection patient outcomes.

**Methods**: Patients who received antibiotics for an infection during an ICU stay were selected from the MIMIC-IV dataset. Demographic, outcome, obesity diagnosis, height, and weight data were extracted from relevant tables. Antibiotic information was used to calculate patients' treatment lengths and whether they were re-treated. Patients were grouped into categories (i.e., healthy, overweight, obese, and morbidly obese) according to diagnoses and (Body Mass Index) BMI. Statistical analysis was performed using SciPy a free open-source Python library and statsmodels.

**Results**: The final dataset contained 19,612 healthy patients, 2,405 patients classed as overweight, 3,803 diagnosed with obesity, and 1,543 individuals with chronic obesity. The mean BMI over the entire population was 29.18, average BMI for each group was 22.40, 27.38, 33.34, and 46.28, respectively. The mean ICU length of stay (LOS) was 5.86 for healthy individuals but much greater for the other groups at 7.98 for overweight patients, 7.14 for obese individuals and 8.14 for those with chronic obesity. Subsequent statistical analysis through a one-way ANOVA (analysis of variance), the pairwise Tukey method and Kruskal-Wallis Test confirmed a statistically significant (alpha = 0.05) difference in LOS between all groups, except those who are overweight and those with chronic obesity. Similar results were obtained for antibiotic treatment length with all p-values being statistically significant other than for obese and overweight populations. Comparing categorical outcome variables re-treatment and death through the Chi-Square test of independence also rejects the null hypothesis and shows statistically different outcomes between groups.

**Conclusions**: Co-morbid obesity leads to significantly worse infection outcomes including extended antibiotic treatment and increased length of stay. Future research will aim to further understand the impact of co-morbidities, such as obesity, on antibiotic management and explore how to most appropriately model multi-morbidity within data-driven clinical decision support systems.

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